

A solubility curve for potassium nitrate

Safety

Wear eye protection throughout the experiment.

Beware of boiling or hot water, and take care when stirring the potassium nitrate solution.



Eye protection
must be worn

Aims

To plot a solubility curve for potassium nitrate in aqueous solution.



Apparatus

Safety goggles

Bench mat

250cm³ capacity beaker (half fill with water)

50cm³ measuring cylinder

Boiling tube

Bunsen burner

Tripod

Gauze

Retort stand, boss and clamp

Thermometer

Distilled water

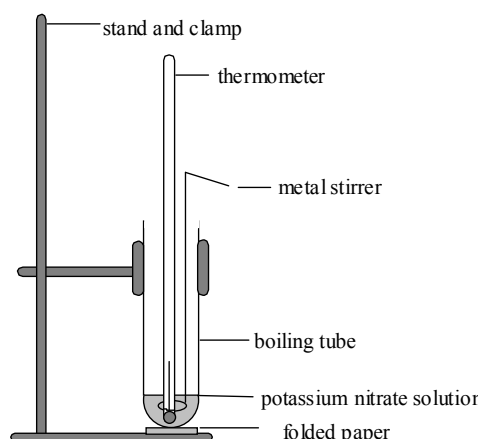
Small piece of folded paper

Potassium nitrate

Balance

Methods

1. Carefully weigh out your assigned mass of potassium nitrate on a folded sheet of paper. Slide the weighed potassium nitrate carefully into the boiling tube.
2. Add 20cm³ of water (measure carefully) to the boiling tube. 20cm³ of water has a mass of 20g.
3. Half fill the beaker with tap water. Clamp the boiling tube firmly, and place it in the beaker of water. Warm the beaker, and stir the contents of the boiling tube with the thermometer. Continue until all the solid has dissolved.
4. Remove the boiling tube from the beaker and re-clamp it as shown in the diagram on the right.
5. Put the thermometer in the boiling tube, and stir **continuously** until tiny flakes of solid start to crystallise. Note the temperature as soon as this happens.
6. When you have noted your result, carefully discard the potassium nitrate solution down the sink (**care:** it will be hot - leave it to cool further if you are not sure).
7. Allow the remaining apparatus to cool before cleaning it and putting it away.
8. Add your results to the class results, then complete the tasks on the reverse of this sheet.



Results

1. Use your own results, and those of the rest of the class, to make a table like the one below. Two extra results have been included to start you off.

Mass of potassium nitrate dissolved in 20g of water (g)	Solubility of potassium nitrate (g solute per 100g water)	Temperature at which the solution is just saturated ($^{\circ}\text{C}$)
2.70	13.5	0
6.30	31.5	20

2. Plot a graph of the class results. Plot the temperature along the horizontal axis (in the range 0 – 100 $^{\circ}\text{C}$), and plot the solubility along the vertical axis (in the range 10 – 150 g per 100g of water).

Analysis and Questions

Answer the following questions **in full sentences**.

Where you have to do a calculation, make sure that you show all your **working out**.

1. Describe the graph: how does the solubility of potassium nitrate vary with temperature of solution?
2. What is the solubility of potassium nitrate at 50 $^{\circ}\text{C}$?
3. At what temperature is the solubility of potassium nitrate 65g per 100g water?
4. How much potassium nitrate will dissolve in 50g of water at 60 $^{\circ}\text{C}$?
5. What is the solubility of potassium nitrate at:
 - i) 70 $^{\circ}\text{C}$;
 - ii) 40 $^{\circ}\text{C}$?

How much solid potassium nitrate will crystallise out when a saturated solution of potassium nitrate made using 100g of water is cooled from 70 $^{\circ}\text{C}$ to 40 $^{\circ}\text{C}$?

Hint: work out the difference between answer (i) and answer (ii).

6. If a saturated solution of potassium nitrate in 25g of water is cooled from 70 $^{\circ}\text{C}$ to 40 $^{\circ}\text{C}$, what mass of solid potassium nitrate will crystallise out?

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Teacher's Notes

To run the practical, each pair of pupils must be assigned a mass of potassium nitrate to use. The suggested range is 8g to 30g for 12 pairs.

If the class is weak, or contains weaker individuals, assign the lower masses of potassium nitrate to the most able (because these take longest to do, and need patience and skill).

Alternatively, copy and cut out the following masses to put into a hat for random draw.

8g	8g	
8g	16g	24g
10g	18g	26g
12g	20g	28g
14g	22g	30g

Solubility of potassium nitrate – class results

Mass of potassium nitrate dissolved in 20g of water (g)	Solubility of potassium nitrate (g solute per 100g water)	Temperature at which the solution is just saturated (°C)
2.7	13.5	0
6.3	31.5	20
8	40	
10	50	
12	60	
14	70	
16	80	
18	90	
20	100	
22	110	
24	120	
26	130	
28	140	
30	150	

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Technician's Notes

Per class:

minimum of 3 top pan balances

solid potassium nitrate (anhydrous) (approximately 240g needed for practical)

divide this into three portions approximately 80g each, and place next to balances in labelled beakers with a spatula for each portion

pieces of scrap paper for weighing out the solid

Per pair:

1 x boiling tube (Pyrex)

1 x thermometer

1 x tripod

1 x gauze

1 x retort stand, boss and clamp

1 x beaker (250cm³ capacity)



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